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PULPWOOD YIELDS FROM EXPERIMENTAL THINNINGS IN OLD-FIELD STANDS OF LOBLOLLY AND SHORTLEAF PINES

By

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This paper releases data gathered in current investigations at the Southern Forest Experiment Station, and is subject to correction or modification following further investigation.

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By Henry Bull, Associate Silviculturist,
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The current expansion of the pulp and paper industry in the South has resulted in an increased need and demand for information on thinning practices applicable to the commercial production of pulpwood from southern pines. In some cases pulpwood constitutes the main crop, but frequently it is desired to cut pulpwood only in thinnings while raising a main crop of high-quality sawlogs, poles, or other products of comparatively high value per unit of volume. It is generally considered that integrated utilization in which pulpwood is cut only in thinnings will yield a much higher net annual return per acre to the average owner than will the production of pulpwood as the only crop.

Granting that pulpwood can be, and for the most part should be and will be, cut in commercial quantities in thinnings, what kind of thinnings are advisable, when and how can they be made to produce the greatest profit, and what will they yield? All of these questions cannot be answered completely at the present time since such answers are usually obtainable only from a large number of permanent sample plots maintained and measured over long periods of time. Complete records of this sort are not yet available in the South. Long before the final outcome of sample-plot studies is known, however, information obtained at interim remeasurements may be put to practical use.

Preliminary data from 25 permanent sample thinning and control plots (including the oldest plots of this kind in the South) are presented in this paper in the belief that figures from actual thinned and unthinned stands are valuable as examples of what certain stands actually produce when given certain treatments. Each plot record to date constitutes a case history of a specific stand that was treated in a given way and that has so far produced and now contains certain amounts of pulpwood. Examples of this sort provide a factual background for the development of pulpwood thinning practices and help in predicting their probable outcome. The reader is cautioned, however, against comparing one plot with another and attempting to use small differences as reliable guides to specific conclusions. The main purposes of this paper are (1) to lend the reality of figures to the general subject of pulpwood thinnings, and (2) to show the large volumes of pulpwood that can be obtained from thinnings while reserving the best trees for a full final crop of sawlogs or other high-quality products.

The plots under consideration are maintained by the Southern Forest Experiment Station in cooperation with the Urania Lumber Company, and are located near Urania, in north-central Louisiana. The plots are entirely in even-aged, old-field stands of loblolly and shortleaf pines, and loblolly is the more common species. The stands were fully stocked to overstocked when

the plots were established. Old-field stands constitute only about 10 percent of the entire forest area in the vicinity of Urania, but in some other parts of the South the proportion is much higher. In the Lower Piedmont Region of Georgia, for example, about two-thirds of the entire forested area is occupied by old-field loblolly and shortleaf pines. Regardless of exact regional percentages, this type not only occupies a very large aggregate area in the South but it is a type that is particularly important as a source of pine pulpwood. Old-field stands containing trees of pulpwood size are usually well stocked to overstocked; the growth rate is rapid for at least the first 10 to 15 years; the stands are usually readily accessible; and there is usually a high proportion of trees that will never make high-quality sawlogs, poles or the like, and that should be removed to improve growing conditions for the best trees that will (or should) make up the final crop. Old-field stands should continue to be one of the principal sources of loblolly and shortleaf pine pulpwood for a considerable period.

Since the data presented here were obtained entirely from even-aged old-field stands, the indicated growth rates are directly applicable only to such stands. It is possible, however, to use these data to obtain estimates of growth in relatively pure even-aged stands of loblolly and shortleaf pines on cut-over land by making allowance for differences in density. The simplest way to adjust for density is on the basis of the number of pines per acre. If, for example, for the same age and site quality, a stand on cut-over land contains 60 percent as many trees per acre as an old-field plot for which data are given here, then the growth and yield would be estimated to be 60 percent as great as the values given. For pure or relatively pure even-aged stands, this method of making rough estimates should give conservative values, because with fewer trees per acre the individual trees have more growing space and should therefore be growing faster than if they occurred in more crowded old-field stands. If the stand on cut-over land is not relatively pure pine--i.e., if it contains a large number of hardwoods in the main crown canopy--estimates of growth based on the old-field data presented here will be subject to such large probable errors as to be of little or no value.

Data from 25 plots are presented. Of these, 8 are check or control plots which have never been thinned. The volumes cut and left at establishment and at 5-year intervals thereafter are given entirely in standard rough or unpeeled cords of 128 cubic feet (4 by 4 by 8 feet). They represent the approximate volumes of merchantable pulpwood contained in trees more than 4.5 inches in diameter at breast height and to a flexible top diameter of about 4 inches inside bark. Cords are of course very rough and variable units of volume and it should be clearly understood that the values given here are necessarily approximate and not precise. The cord unit is used because of the general commercial practice of dealing with pulpwood entirely in that unit. The average size of the crop trees, usually intended for high-quality sawlogs on these plots, is roughly indicated by the average diameter of the 100 largest trees per acre.

The figures given on pages 5 to 9 largely speak for themselves, but a few points of special interest deserve brief mention:

(1) Most of the thinnings, especially the earlier ones, were relatively light and removed only the smaller trees (as shown by the smaller average d.b.h. of the trees cut). In some cases the thinnings were so light that pulpwood-size trees in the residual stands died before the next thinning (although this was not always due entirely to competition).

(2) The average annual mortality per acre for a 5-year period in trees of pulpwood size in unthinned plots amounted to less than 0.1 cord in stands up to 20 years old, ranged from less than 0.1 to about 0.7 cord in stands 21 to 30 years old, and ranged from about 0.3 to 0.7 cord in stands 31 to 37 years old. Stands in the last age group are evidently on the threshold of high mortality of pulpwood-size trees, because these stands still contain some 3 to 5 times more trees than will be present in the final crop, and all of the trees are already of pulpwood size.

(3) The average annual growth in pulpwood volume for a 5-year period in thinned stands has ranged from 0.7 to 2.7 cords per acre, with most stands adding from 1 to 2 cords annually. The similar growth in unthinned stands has ranged from 0.1 to 2.9 cords per acre, with approximately the same median growth as in the thinned stands.

(4) Starting at about 20 years, on all but the poor sites, a heavy thinning that removes about one-half of the entire pulpwood volume will yield at least 10 cords per acre and still leave the best (straighest, cleanest, fast-growing, sound) trees for possible increased growth and at least one more good cut of pulpwood before the final harvest of sawlogs or other relatively high-quality products.

(5) The best thinning practices--those most profitable in the long run--are not yet certain. Early thinnings produce little or no pulpwood and may produce limby trees, but should increase the growth rate of the residual trees if made early enough and heavy enough. Late thinnings produce large volumes of pulpwood and relatively clean trees, but are usually too late to increase the growth rate of the residual trees and may be too late to save a considerable volume of pulpwood from loss through mortality. This uncertainty as to the very best practice, however, should not deter anyone from thinning for pulpwood. A timber owner may not make the last possible cent from his timber, but almost any kind of a thinning that removes pulpwood in profitable quantities and still leaves plenty of the best trees for a final crop of higher-quality products will increase both his immediate income and the value of his forest.

Notes on the Data Presented on the Following Pages

Sample plots with the same name (e.g., Maxwell, Castor, etc.) are in the same old-field stand and are therefore grouped together.

After the name and number of each plot there are listed, in order: (1) the principal species of pine and its percentage importance based on representation among the 100 largest trees per acre; (2) the site quality; and (3) the type of thinning, if thinned. "Thinning from below" refers to the cutting of only the smaller trees with very little or no opening up of

the dominant, upper, or principal crown canopy. "Crown thinning" refers to a cutting that opens up the dominant crown canopy through the removal of some of the larger trees. The degree or heaviness of thinning is not given since it is necessarily arbitrary and relative, and since the actual record of trees and cords cut and left in each instance speaks for itself.

Most of the sample plots are rather small (most common size: $\frac{1}{4}$-acre) but the listed data are uniformly based on 1 acre.

"D.B.H." stands for diameter at breast height; i.e., at $4\frac{1}{2}$ feet above the ground.

In certain instances, "pines 5" d.b.h. and more" are listed separately because these are all the pines of pulpwood size--in general commercial practice and as used in this paper.

"Ave. height of dom. and codom. loblolly pines" refers to the average height of the dominant and codominant loblolly pines, i.e., the average height of the main crown canopy of the more common species.

"Average d.b.h." is the diameter corresponding to the average basal area, determined by dividing the total basal area by the total number of trees.

DATA FROM PERMANENT SAMPLE PLOTS. BASIS: 1 ACRE.

THINNED PLOTS

Date	Total age	Ave. height of dom. and codom. loblolly pines	Number of pines		Range in d.b.h.		Average d.b.h.				Approx. volume in rough cords	
							Left		Cut			
			Left	Cut	Left	Cut	All pines	100 largest in d.b.h. per acre	All pines	Pines 5" d.b.h. and more	Left	Cut
	Years	Feet					Inches					
MAXWELL U-5: 75% loblolly in 1915; 100% loblolly in 1935. Good site. Thinnings from below.												
1915	8		1,144	688	0- 5	0- 3	1.6	3.2	0.8	-	0	0
1920	13	29	1,256	160	0- 7	0- 7	3.7	6.3	2.9	7.2	6.2	0.1
1925	18	45	424	468	3- 9	1- 8	6.3	8.0	4.2	5.5	15.4	4.5
1930	23	54	320	68	5-11	4- 9	7.8	9.3	6.4	6.5	22.8	3.0
1935	28	62	232	88	5-12	5-12	8.8	10.1	8.4	8.4	24.5	8.4
TOTAL												16.0
MAXWELL U-55: 100% loblolly. Good site. Crown thinnings.												
1925	18	50	488	296	2-10	3- 8	5.6	7.9	5.2	6.0	13.8	5.5
1930	23	56	288	144	3-12	4- 8	7.2	9.4	5.7	5.9	17.5	4.1
1935	28	67	156	84	3-14	7-13	8.5	10.0	9.2	9.2	16.2	10.5
TOTAL												20.1
MAXWELL U-56: 99% loblolly. Good site. Crown thinnings.												
1925	18	47	772	476	2- 8	2- 7	4.6	6.8	4.4	5.5	11.4	4.3
1930	23	53	496	144	2-10	4- 9	6.0	8.1	5.1	5.6	17.7	2.6
1935	28	64	308	108	3-12	5-10	6.9	9.0	7.8	7.8	18.6	8.9
TOTAL												15.8

UNTHINNED CHECK OR CONTROL PLOT

Date	Total age	Ave. height of dom. and codom. loblolly pines	Number of pines	Range in d.b.h.	Average d.b.h.		Approx. volume in rough cords	Pines 5" d.b.h. and more that died within 5 years after given date			
					All pines	100 largest in d.b.h. per acre		Number	Range in d.b.h.	Average d.b.h.	Approx. volume in rough cords
	Years	Feet			Inches				Inches		
MAXWELL U-3: 75% loblolly in 1915; 100% loblolly in 1935. Good site.											
1915	8		1,328	0- 4	1.5	3.2	0	0			
1920	13	32	1,280	0- 8	3.7	6.4	7.1	0			
1925	18	49	816	1-10	5.5	8.3	21.7	8	5-7	5.9	0.3
1930	23	59	600	2-12	6.9	9.7	30.8	56	5-7	5.4	1.6
1935	28	69	476	3-14	8.0	10.7	43.4				
TOTAL								64			1.9

THINNED PLOTS

Date	Total age	Ave. height of dom. and codom. loblolly pines	Number of pines		Range in d.b.h.		Average d.b.h.				Approx. volume in rough cords	
							Left		Cut			
			Left	Cut	Left	Cut	All pines	100 largest in d.b.h. per acre	All pines	Pines 5" d.b.h. and more	Left	Cut
	Years	Feet					Inches					
MAXWELL U-53: 95% loblolly. Fair site. All pines 4.6" d.b.h. and larger cut in 1925; all 6.0" d.b.h. and larger cut in 1935.												
1925	18	38	347	555	1- 4	4- 9	3.4	3.9	6.0	6.0	0	18.6
1930	23	39	314	0	2- 6	-	4.6	5.6	-	-	3.9	0
1935	28	48	164	128	2- 6	6- 8	4.5	5.2	7.0	7.0	2.1	6.6
TOTAL												25.2
MAXWELL U-54: 100% loblolly. Good site. Crown thinning.												
1925	18	46	100	664	5-10	1-11	7.5	7.5	5.3	6.5	5.7	15.3
1930	23	54	96	0	6-14	-	9.6	-	-	-	10.6	0
1935	28	64	96	0	7-15	-	11.2	-	-	-	17.1	0
CASTOR U-14: 100% loblolly. Very good site. Thinnings from below.												
1915	21	63	352	208	5-11	4- 8	7.8	9.5	6.1	6.1	29.5	9.4
1920	26	72	248	96	6-12	5- 8	9.1	10.4	6.6	6.6	31.3	5.6
1925	31	79	244	0	7-14	-	9.9	11.5	-	-	41.7	0
1930	36	84	200	44	7-15	7- 9	11.2	12.5	8.1	8.1	46.0	4.5
1935	41	90	180	16	8-17	8-10	12.1	13.3	9.0	9.0	52.5	2.4
TOTAL												21.9
CASTOR U-15: 100% loblolly. Very good site. Thinnings from below.												
1915	21	61	264	364	5-11	4-10	7.8	9.2	6.1	6.4	21.5	15.4
1920	26	69	184	80	6-13	5- 9	9.2	10.2	7.0	7.0	23.8	5.3
1925	31	79	184	0	7-15	-	10.4	11.6	-	-	34.5	0
1930	36	85	140	44	8-16	8-13	11.8	12.6	9.8	9.8	36.8	7.6
1935	41	88	140	0	9-18	-	12.7	13.5	-	-	44.5	0
TOTAL												28.3

UNTHINNED CHECK OR CONTROL PLOT

Date	Total age	Ave. height of dom. and codom. loblolly pines	Number of pines	Range in d.b.h.	Average d.b.h.		Approx. volume in rough cords	Pines 5" d.b.h. and more that died within 5 years after given date			
					All pines	100 largest in d.b.h. per acre		Number	Range in d.b.h.	Average d.b.h.	Approx. volume in rough cords
	Years	Feet		Inches					Inches		
CASTOR U-13: 100% loblolly. Good site.											
1920	26	64	416	4-11	7.6	9.5	32.7	24	5- 6	5.6	0.9
1925	31	71	392	4-13	8.3	10.6	40.5	72	5- 8	6.3	3.7
1930	36	80	320	4-14	9.4	11.6	47.5	44	5-10	7.1	3.3
1935	41	86	272	6-16	10.2	12.4	53.4				
TOTAL											

THINNED PLOTS

Date	Total age	Ave. height of dom. and codom. loblolly pines	Number of pines		Range in d.b.h.		Average d.b.h.				Approx. volume in rough cords	
							Left		Cut			
			Left	Cut	Left	Cut	All pines	100 largest in d.b.h. per acre	All pines	Pines 5" d.b.h. and more	Left	Cut
	Years	Feet					Inches					
MAYES U-10: 88% loblolly. Poor site. Thinnings from below.												
1915	22	52	344	692	2-11	1- 7	6.4	8.4	3.8	5.3	14.8	4.1
1920	27	56	312	28	3-12	2- 6	7.1	9.1	4.0	6.0	17.9	0.3
1925	32	62	272	40	4-13	4- 8	7.8	9.8	5.9	6.4	21.6	1.4
1930	37	63	272	0	4-15	-	8.2	10.5	-	-	25.2	0
1935	42	67	160	92	4-16	5-13	9.4	10.7	7.5	7.5	21.3	7.2
TOTAL												13.0
MAYES U-11: 86% loblolly. Poor site. Thinnings from below.												
1915	22	51	584	408	2-10	2- 7	5.8	8.0	4.0	5.3	17.9	2.0
1920	27	56	460	112	3-11	2- 8	6.5	8.7	4.1	6.4	21.6	0.6
1925	32	60	360	100	4-12	3- 8	7.2	9.4	5.2	5.4	24.1	2.6
1930	37	63	276	76	5-13	4- 8	8.2	10.2	5.6	5.8	25.7	2.6
1935	42	67	204	72	5-14	5- 9	9.0	10.7	7.1	7.1	24.3	4.8
TOTAL												12.6
MAYES U-115: 82% shortleaf. Poor site. Crown thinning.												
1935	42	69	168	464	3-11	4-12	7.2	8.6	6.4	6.5	12.1	24.3
MAYES U-116: 90% loblolly. Poor site. Crown thinning.												
1935	42	73	68	284	3-16	4-14	11.0	-	7.7	7.9	14.1	24.6

UNTHINNED CHECK OR CONTROL PLOT

Date	Total age	Ave. height of dom. and codom. loblolly pines	Number of pines	Range in d.b.h.	Average d.b.h.		Approx. volume in rough cords	Pines 5" d.b.h. and more that died within 5 years after given date			
					All pines	100 largest in d.b.h. per acre		Number	Range in d.b.h.	Average d.b.h.	Approx. volume in rough cords
	Years	Feet		Inches					Inches		
MAYES U-12: 88% loblolly in 1915; 92% loblolly in 1935. Poor site.											
1915	22	52	928	2-13	5.3	8.7	22.5	12	5	4.8	0.3
1920	27	55	724	3-14	6.0	9.3	26.3	24	5	5.1	0.6
1925	32	63	540	3-14	6.8	9.9	32.1	72	5-7	5.3	2.4
1930	37	65	432	4-15	7.5	10.5	33.1	40	5-6	5.3	1.3
1935	42	68	372	4-15	8.0	11.0	36.2				
TOTAL								148			4.6

THINNED PLOTS

Date	Total age	Ave. height of dom. and codom. loblolly pines	Number of pines		Range in d.b.h.		Average d.b.h.				Approx. volume in rough cords	
							Left		Cut			
			Left	Cut	Left	Cut	All pines	100 largest in d.b.h. per acre	All pines	Pines 5" d.b.h. and more	Left	Cut
	Years	Feet					Inches					
HOLLY U-2: 96% shortleaf in 1915; 85% shortleaf in 1935. Good site. Thinnings from below.												
1915	12	25x	760	2,448	0- 7	0- 5	3.6	5.8	1.1	5.0	2.9	0.3
1920	17	39x	808	0	0-10	-	4.8	7.7	-	-	13.8	0
1925	22	51x	648	168	0-11	2- 5	6.0	8.9	3.6	5.1	25.8	0.4
1930	27	60x	360	96	4-12	5- 8	8.0	9.9	6.1	6.1	32.1	4.4
1935	32	66x	240	112	4-13	7-12	8.5	10.1	8.9	8.9	26.3	13.9
TOTAL		x = shortleaf										19.0
ARNOLD U-70: 100% loblolly. Good site. Crown thinning.												
1928	32	76	156	104	6-18	4-11	11.9	13.2	8.0	8.1	37.4	9.6
1933	37	80	148	0	8-19	-	13.5	13.9	-	-	42.6	0

UNTHINNED CHECK OR CONTROL PLOTS

Date	Total age	Ave. height of dom. and codom. loblolly pines	Number of pines	Range in d.b.h.	Average d.b.h.		Approx. volume in rough cords	Pines 5" d.b.h. and more that died within 5 years after given date			
					All pines	100 largest in d.b.h. per acre		Number	Range in d.b.h.	Average d.b.h.	Approx. volume in rough cords
	Years	Feet		Inches				Inches			
HOLLY U-1: 50% loblolly in 1915; 92% loblolly in 1935. Fair site.											
1915	12	26	3,912	0- 6	2.2	5.2	2.3	0			
1920	17	37	1,776	0- 8	3.8	6.7	11.0	0			
1925	22	50	1,096	1-10	5.2	7.9	25.0	16	5	5.1	0.4
1930	27	58	848	2-11	6.1	8.9	35.1	40	5	4.7	0.8
1935	32	65	680	2-13	6.9	9.7	42.9				
TOTAL								56			1.2
ARNOLD U-69: 96% loblolly. Very good site.											
1928	32	82	244	4-19	10.7	13.1	49.9	24	6-7	7.0	1.6
1933	37	85	220	4-20	11.5	13.7	53.0				

THINNED PLOTS

Date	Total age	Ave. height of dom. and codom. loblolly pines	Number of pines		Range in d.b.h.		Average d.b.h.				Approx. volume in rough cords	
							Left		Cut			
			Left	Cut	Left	Cut	All pines	100 largest in d.b.h. per acre	All pines	Pines 5" d.b.h. and more	Left	Cut
	Years	Feet					Inches					
NELSON U-68: 100% loblolly. Good site. Crown thinnings.												
1928	27	64	264	248	6-11	4- 8	8.3	9.4	6.0	6.1	25.8	10.6
1933	32	67	140	116	6-12	6-11	9.3	9.7	8.7	8.7	17.9	12.4
TOTAL												23.0
NELSON U-78: 100% loblolly. Poor site. Crown thinnings.												
1928	27	57	270	220	6-11	4- 8	8.4	9.7	6.1	6.2	24.1	8.5
1933	32	60	85	175	7-12	6-11	10.0	-	8.6	8.6	11.7	16.0
TOTAL												24.5
WHITEHEAD U-65: 100% loblolly. Fair site. Crown thinnings.												
1928	21	52	578	294	2- 9	4- 6	6.2	7.7	4.8	5.3	22.5	4.2
1933	26	54	257	238	3-10	5-10	7.6	8.6	6.8	6.8	17.2	12.0
TOTAL												16.2
ISOM STRANGE U-81: 100% loblolly. Poor site. Crown thinnings.												
1928	21	45	662	252	1-10	4- 7	5.2	7.8	4.6	5.2	14.4	2.4
1933	26	53	402	73	1-11	2-10	6.3	8.6	6.8	7.0	16.4	3.6
TOTAL												6.0

UNTHINNED CHECK OR CONTROL PLOTS

Date	Total age	Ave. height of dom. and codom. loblolly pines	Number of pines	Range in d.b.h.	Average d.b.h.		Approx. volume in rough cords	Pines 5" d.b.h. and more that died within 5 years after given date			
					All pines	100 largest in d.b.h. per acre		Number	Range in d.b.h.	Average d.b.h.	Approx. volume in rough cords
	Years	Feet		Inches					Inches		
NELSON U-79: 100% loblolly. Poor site.											
1928	27	57	574	2-12	6.9	9.4	32.1	104	5-7	5.7	3.5
1933	32	60	448	5-13	7.6	10.1	32.8				
WHITEHEAD U-66: 100% loblolly. Good site.											
1928	21	52	752	1-10	6.2	8.7	28.4	20	5	4.9	0.4
1933	26	60	571	1-12	7.6	9.9	40.1				
ISOM STRANGE U-80: 98% loblolly. Poor site.											
1928	21	48	892	2-10	5.3	8.2	20.3	4	5	4.8	0.1
1933	26	55	664	3-11	6.3	9.0	27.1				